



# Is there a link between cognitive abilities and environmental awareness? Cross-national evidence

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## ABSTRACT

This article explores the effect of cognitive abilities on environmental awareness using data from 119 countries for the period 2005–2015. Our findings provide pioneering confirmation that a facet of human psychology, namely cognitive ability, is positively associated with environmentalism. The empirical estimations indicate that when cognitive abilities increase by one standard deviation, climate change awareness increases by approximately 19% (slightly less than one standard deviation). This positive association remains intact when we control for other determinants of environmentalism.

## 1. Introduction

Several studies illustrate that cognitive ability (intelligence) has numerous implications for society. For example, the association between cognitive ability and various socio-economic issues, including income inequality, economic growth, life satisfaction, and distribution of national happiness has been extensively explored in recent years (Jones, 2011; Ram, 2007; Rindermann et al., 2015; Nikolaev and Salahodjaev, 2016). Indeed, cognitive capitalism theory suggests that if cognitively able individuals earn more income than individuals with a lower level of cognitive skills, then nations with higher average cognitive abilities should be associated with a higher level of per capita wealth than nations with lower average cognitive abilities. It is presumed that economic growth in more cognitively able societies is driven by technological progress, off-farm employment opportunities, and stronger protection of private property and should be systematically associated with lower environmental degradation. Moreover, it may be inferred that, considering that cognitive abilities are significantly correlated with economic development, in developed countries ‘people value [less] material well-being over environmental amenities, [and] once a country reaches a sufficiently high per capita income, people give greater attention to the environment’ (Lopez and Mitra, 2000, p. 137). Thus, economic growth in cognitively able nations may be less dependent on environment-damaging production.

However, the relationship between cognitive abilities and measures of environmental quality is complex. For example, while Squalli (2014) finds that the effect of IQ on emissions of CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O is at best mixed, there is also evidence that cognitive abilities are negatively (Omanbayev et al., 2018) and non-linearly (Salahodjaev et al., 2016)

related to CO<sub>2</sub> emissions. In a similar vein, Salahodjaev (2016), using data from 186 countries, finds that national IQs have a causal effect on global forest cover change during the period between 1990 and 2010.

In this study, we contribute to the extant literature by further exploring the link between cognitive abilities and environmental indicators. In particular, we argue that the weakness of the related psychological and environmental literature is that it overlooks the association between cognitive abilities and national environmental values by focusing only on hard measures of environmental performance. In this study, we argue that beside its direct correlation with environmental indicators, cognitive ability, as a psychological concept, may be linked to the level of environmental concern expressed by the population, and therefore, indirectly associated with ecological degradation. To the best of our knowledge, this is the first article that investigates the link between cognitive abilities and environmental values across nations, measured by the share of the population that is aware of global warming or climate change.

There are several arguments for why societies in countries with higher levels of cognitive abilities are more likely to be aware of global climate change. First, cognitively able societies are more likely to adopt effective and accountable institutions (Kanyama, 2014). These institutions, which endorse freedom of the press, civil rights and political liberties, are more likely to inform society about existing environmental issues (Rindermann, 2008). Moreover, efficiently functioning institutions in cognitively able societies create the impetus for agents to act legally and increase the costs of underground activities that are associated with environmental degradation such as air pollution or illegal logging (Salahodjaev, 2015). Consequently, bureaucrats in these institutions are less likely to engage in rent-seeking and ‘respond through the implementation of environmental legislation, appropriate tax-

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subsidy policies, and other measures that lead to a better environment' (Lopez and Mitra, 2000, p. 137).

Cognitively able societies are also more likely to be environmentally concerned and more patient (Jones and Podemska, 2010) and tend to 'make choices that focus on generating long-run rather than short-run gains' (Squalli, 2014, p. 34). For example, higher IQ societies are associated with less corruption (Potrafke, 2012) and more efficient use of natural wealth (Obydenkova and Salahodjaev, 2016). Indeed, cognitive abilities are instrumental to social orders such as trust (Sturgis et al., 2010). This is pivotal to the competence of people to cultivate empathy and to solve common problems such as environmental degradation. Furthermore, cognitive abilities predict political behaviour such as liberalism, political participation, and the probability of voting for parties with environmental agendas (Solon, 2014), which is instrumental for the development of environmental protection. Similarly, Obydenkova and Salahodjaev (2017) report that both political institutions and cognitive skills are instrumental to implementing climate change policies across developed and developing nations.

Most importantly, according to the Savanna-IQ interaction hypothesis (otherwise known as the *intelligence paradox*), cognitively able societies are more likely to adopt and nurture evolutionary novel behavioural tendencies such as environmentalism that our ancestors did not exhibit (Kanazawa, 2010, 2012). Indeed, in his work on the role of IQ in shaping the values of nations, Kanazawa (2009) concludes by stating that 'future empirical work must consider other evolutionarily novel and familiar values besides the ones considered and tested in this paper...[M]ore intelligent individuals are more likely to espouse such other evolutionarily novel values as feminism and environmentalism' (p. 553).

The inferred association between cognitive abilities and environmentalism is examined in a sample of 119 nations for the period 2005–2015. The estimates suggest that an increase in average cognitive skills at a national level by one standard deviation increases climate change awareness by approximately 19% (slightly less than one standard deviation). This link remains robust even after controlling for other socio-economic antecedents of environmentalism.

## 2. Data and methods

### 2.1. Dependent variable

The dependent variable in this study is the national level of climate change awareness. This variable is measured as a share of a country's population who respond that they are 'aware' on the survey question 'How much do you know about global warming or climate change?'. The data is from the largest cross-sectional survey of climate change perceptions conducted by the Gallup World Poll in 119 countries, representing over 90% of the world's population. The climate change awareness levels range from 20% in Liberia to 98% in Japan.

### 2.2. Independent variable

Our main independent variable is the national average of cognitive abilities. In his study, Rindermann (2007) measures a common cognitive ability at the macro-social level for 194 countries and geopolitical regions. To estimate the index, the author uses data from nationally administered IQ tests, school assessment tests (e.g., TIMSS or PISA), and adult literacy studies. For interpretation purposes, the final scores are rescaled by setting the g-factor in Britain at 100 (standard deviation = 15) and the scores for the remaining countries are adjusted for this scale. To present the association between cognitive abilities and environmental awareness, we present correlations between cognitive ability index scores and our dependent variable. Fig. 1 displays preliminary evidence that overall cognitive abilities are positively associated with climate change awareness. For instance, the correlation between the cognitive abilities index and climate change awareness is  $r = 0.84$ .

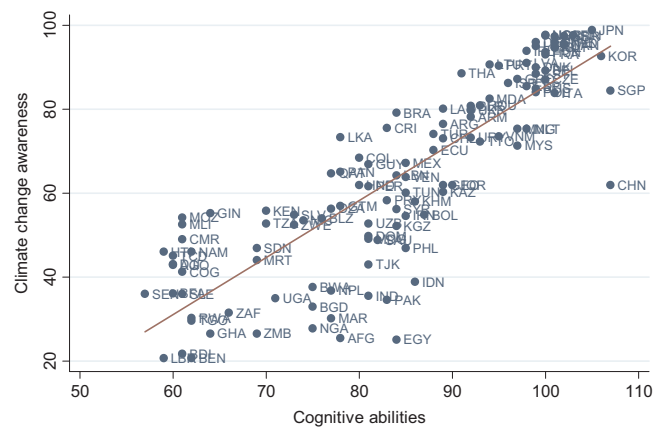


Fig. 1. Cognitive abilities and climate change awareness. Source: Rindermann (2007); Lee et al. (2015).

It is also probable that increase in cognitive abilities is not in itself responsible for the increase in climate change awareness; other variables correlated with economic development and demographic change may explain cross-national variations in environmentalism.

#### 2.2.1. GDP per capita

Empirical literature documents that GDP per capita follows a non-monotonic association with environmental indicators, referred to as the environmental Kuznets curve relationship. Stern (2004) argues that '[i]n the early stages of economic growth degradation and pollution increase, but beyond some level of income per capita, which will vary for different indicators, the trend reverses, so that at high income levels economic growth leads to environmental improvement' (p. 1419). For example, Chow and Li (2014), using data for 132 nations for the period between 1992 and 2004, finds that there is an inverted U-shaped association between air pollution and GDP per capita. In a similar vein, Bhattarai and Hammig (2001) infer a non-monotonic relationship between economic development and deforestation. Based on previous studies, we estimate a cubic form econometric specification for a more flexible interpretation of the environmental Kuznets curve hypothesis.

#### 2.2.2. Political institutions

It is believed that democratic regimes create the necessary conditions to foster fair distribution of resources and power and provide essential civil liberties and political rights, which in turn form the necessary social, political, and economic conditions that lead to greater environmentalism. Widespread citizen involvement in political matters and electoral competitions increases the stringency of environmental policymaking. In democratic societies, individuals have greater access to information (via press freedom), and thus, are more informed about existing environmental problems. Moreover, in democratic regimes 'non-governmental organizations that can work to help inform the public about environmental problems, can act as watchdogs on public agencies, and can directly lobby members of government' (Winslow, 2005, p. 772). However, recent evidence suggests that '[environmental degradation] radically increases over the process of political regime transition: from non-democratic regimes to higher levels of democracy' (Obydenkova et al., 2016, p. 485). In weak democratic regimes, the ruling elite, driven by populism, allocate greater resources to achieve rapid economic growth and fail to focus on existing environmental issues. Thus, in line with existing literature (Buitenzorg and Mol, 2011), we include the democracy index and its squared term to test whether environmental awareness declines in countries with weak democratic regimes. The democracy index is calculated as a mean of civil liberties and political rights indices from Freedom House. In our study, this index ranges from 1 (least democratic) to 7 (most democratic).

**Table 1**  
Descriptive statistics.

Variable	Description	Mean	Std. Dev.	Min	Max
Climate change awareness	Percent of population that is aware of global warming or climate change from Lee et al. (2015)	63.65	22.55	20.62	98.92
Cognitive abilities	National index of cognitive abilities from Rindermann (2007)	81.59	14.14	55	107
Income	GDP per capita (constant 2005 US\$) from World Bank	12.02	19.27	0.14	126.60
Democracy index	Average of civil liberties and political rights indices from Freedom House	4.73	1.96	1	7
Population size	Total population (log) from World Bank, 2005	15.12	2.35	9.18	20.99
Globalization	Globalization index from Lee et al. (2015)	60.46	16.39	24.37	92.81
Bio-capacity	Total bio-capacity from Lee et al. (2015)	3.52	6.64	0.02	62.94

### 2.2.3. Other control variables

Besides democracy and GDP per capita, we also include other control variables. We control for the population size to capture the effect of the resource base. We also add the globalization index as there is empirical evidence that globalization enhances social values such as tolerance (Berggren and Nilsson, 2015). Finally, we control for the total bio-capacity as a proxy for the existing biological stock. The descriptive statistics for the main variables used in this study are presented in Table 1.

### 2.3. Empirical model

The baseline regression for the empirical analysis is:

$$EAC_i = \alpha_0 + \alpha_1 CA_i + X\beta + \varepsilon_i \quad (1)$$

in which EAC is the climate change awareness level in a country, CA is the common cognitive ability at the macro-social level, X is the vector of control variables, and  $\varepsilon$  is the normally distributed error term. The correlation matrix for our main variables is presented in Table 2.

## 3. Results

The main results are reported in Table 3. In specification (1), we depart from a simple bivariate econometric equation without including control variables. We find that the estimate for cognitive abilities is positive and significant at the 1% level. The quantitative meaning of the estimated coefficient is that when the common cognitive ability at the macro-social level increases by one standard deviation, climate change awareness increases by approximately 19% (slightly less than one standard deviation). Moreover, this specification offers strong evidence of the positive effect of cognitive abilities on environmentalism with an adjusted goodness of fit of 71%.

In specification (2), income terms are added to the econometric model. As expected, GDP per capita is non-linearly associated with awareness of climate change. The estimated turning points are US \$30,500 and US\$58,300. This suggests that in low-income and high-income countries, populations tend to become more environmentally concerned as GDP per capita increases. The estimate for a common cognitive ability at the macro-social level retains its statistical significance. In specifications (3) and (4) we further control for the democracy index. In line with related studies, the association between political institutions and climate change awareness has an inverted U-shape pattern and is marginally statistically significant. The estimate

**Table 2**  
Correlation matrix.

	I	II	III	IV	V	VI	VII
Awareness	1						
Cognitive abilities	0.84	1					
GDP per capita	0.67	0.59	1				
Democracy	0.53	0.44	0.53	1			
Population size, log	−0.08	0.10	−0.16	−0.17	1		
Globalization index	0.76	0.75	0.73	0.69	−0.05	1	
Bio-capacity total	0.18	0.11	0.09	0.21	−0.28	0.10	1

**Table 3**  
Main results.

	(1)	(2)	(3)	(4)	(5)
Cognitive abilities	1.362*** (0.078)	0.949*** (0.119)	0.941*** (0.119)	1.016*** (0.102)	0.982*** (0.121)
GDP per capita		1.600*** (0.496)	0.994* (0.518)	0.221*** (0.053)	0.149** (0.063)
GDP per capita squared		−0.037** (0.015)	−0.022 (0.015)		
GDP per capita cube		0.000** (0.000)	0.000 (0.000)		
Democracy			−4.498 (3.042)	−5.551* (3.005)	−6.169** (2.955)
Democracy squared			0.675+ (0.350)	0.851** (0.344)	0.832** (0.337)
Population size (log)					−1.251 (0.782)
Globalization index					0.156 (0.137)
Bio-capacity total					0.163* (0.092)
Constant	−50.730*** (6.830)	−23.724*** (8.623)	−16.635 (10.632)	−19.873** (9.871)	−2.311 (15.388)
N	119	118	118	118	118
adj. R <sup>2</sup>	0.710	0.765	0.771	0.770	0.778

Standard errors in parentheses.

\* p < 0.1.

\*\* p < 0.05.

\*\*\* p < 0.01.

for cognitive abilities is statistically significant at the 1% level and quantitatively unaffected.

Finally, in specification (5) the remaining control variables are added to the regression. Of these additional variables, only total bio-capacity is statistically significant, displaying a positive association with climate change awareness. In addition, democracy and its squared term are now statistically significant at the 5% level, exhibiting a Kuznets curve type of relationship with climate change awareness. Our main variable of interest, cognitive abilities, preserves its statistical significance.

Therefore, the results reported in Table 3 indicate that cognitive abilities are significantly linked with a nation's level of climate change awareness in the cross-country sample.

We assessed the strength of our findings in a number of ways. First, we used a vector of alternative control variables in specification (1) of Table 4. To capture the stringency of environmental policy, we included the maximum allowed lead content in gasoline, in grams per litre, from Lovei (1997). We also added a binary variable for China as it seems to be a clear outlier in Fig. 1. Finally, we controlled for the level of corruption, measured by the control of corruption index from World Bank. Of these alternative control variables, only a binary variable for China

**Table 4**  
Robustness test.

	(1)	(2)
Cognitive abilities	1.089*** (0.142)	1.066*** (0.138)
Income	0.223** (0.094)	0.229* (0.137)
China	−23.491*** (4.230)	−22.584** (11.134)
Environmental stringency	−0.042 (0.058)	−0.052 (0.055)
Corruption	2.225 (2.141)	2.509 (2.356)
Constant	−28.685** (12.948)	−26.711** (12.289)
N	84	84
adj. R <sup>2</sup>	0.765	0.757
Weights	None	Population size

Standard errors in parentheses.

\* p &lt; 0.1.

\*\* p &lt; 0.05.

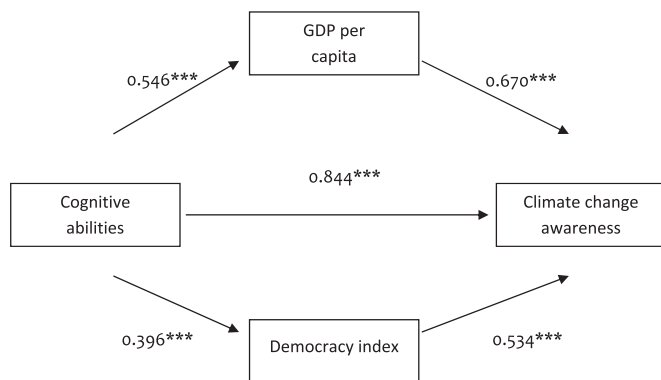
\*\*\* p &lt; 0.01.

was negative and statistically significant. This may be driven by the size of the total population in China. Therefore, we re-estimated the results reported in specification (1) using weighted regression in which the weights for each country were assigned based on its total population. The effect of cognitive abilities is identical to the baseline results in Table 3.

Additionally, it is possible that cognitive abilities may be indirectly linked to climate change awareness via political regimes or income. Moreover, the quantitative decrease of the estimate for cognitive abilities in the multivariable regression lends support for the existence of an indirect association. Therefore, we conducted a path analysis as displayed in Fig. 2. Indeed, the coefficients from the path analysis strongly suggest that the indirect effect of cognitive abilities influences via democracy and GDP per capita.

In addition, in Table 5 we tested whether our results are sensitive to the inclusion of freedom of mass media (Obydenkova, 2008), trade openness (Libman and Obydenkova, 2015), or government integrity. Again, the effect of cognitive abilities is significant and positive.

As a final robustness test, we used Lynn and Vanhanen's (2012) data on cognitive abilities. Several studies have indicated that cognitive abilities, as researched by Lynn and Vanhanen (2012), may serve as a proxy for human capital (Lynn and Mikk, 2007) and are strong correlates of economic growth (Burhan et al., 2014), financial development (Hafer, 2016), and economic outcomes (Meisenberg, 2012). The results are reported in Table 6. Again, cognitive abilities significantly predict climate change awareness.



**Fig. 2.** Standardized path estimates between cognitive abilities, democracy index, GDP per capita and climate change awareness. Significance at the 1% level is denoted by \*\*\*.

**Table 5**  
Robustness test: alternative controls.

	(1)	(2)	(3)	(4)
Cognitive abilities	1.089*** (0.123)	1.030*** (0.119)	1.007*** (0.121)	1.137*** (0.118)
GDP per capita	0.124* (0.065)	0.203** (0.088)	0.148** (0.060)	0.203* (0.107)
Democracy	−7.834*** (2.771)	−4.924 (3.309)	−5.523* (2.954)	−7.044** (3.245)
Democracy squared	0.923*** (0.322)	0.729* (0.374)	0.715** (0.344)	0.876** (0.388)
Population size (log)	−1.211 (0.877)	−1.346* (0.798)	−1.825** (0.854)	−1.272 (1.061)
Globalization index	0.059 (0.151)	0.058 (0.133)	0.198 (0.138)	−0.067 (0.168)
Bio-capacity total	0.099 (0.251)	0.130 (0.091)	0.170** (0.084)	0.020 (0.272)
Press freedom	−0.174** (0.074)			−0.188** (0.080)
Government integrity		−0.026 (0.086)		−0.041 (0.100)
Trade as % of GDP			−0.030* (0.016)	0.005 (0.026)
Constant	4.437 (16.827)	−1.174 (15.943)	5.064 (15.757)	7.854 (17.432)
N	113	113	118	108
adj. R <sup>2</sup>	0.787	0.768	0.779	0.779

Standard errors in parentheses.

\* p &lt; 0.1.

\*\* p &lt; 0.05.

\*\*\* p &lt; 0.01.

**Table 6**  
Robustness test: Lynn and Vanhanen (2012) data.

	(1)	(2)
Cognitive abilities	1.769*** (0.114)	1.272*** (0.162)
GDP per capita		0.154*** (0.058)
Democracy		−5.871* (3.099)
Democracy squared		0.755** (0.358)
Population size (log)		−1.246 (0.752)
Globalization index		0.188 (0.129)
Bio-capacity total		0.169* (0.078)
Constant	−87.411*** (9.946)	−29.963* (16.730)
N	119	118
adj. R <sup>2</sup>	0.720	0.783

Robust standard errors in parentheses.

\* p &lt; 0.1.

\*\* p &lt; 0.05.

\*\*\* p &lt; 0.01.

#### 4. Conclusion

Ample empirical studies have investigated the antecedents of the determinants of climate change awareness and environmentalism, but these articles have overlooked the importance of human psychology. This paper is concentrated on one aspect of human psychology, namely cognitive ability, using data for the period from 2005 to 2015. Related literature indicates that cognitive abilities are strong predictors of the quality of institutions (Kanyama, 2014) and capture the role of social-cognitive capital in sustainable development (Obydenkova and Salahodjaev, 2017). For example, extant research, using individual survey data from the UK, infers that cognitive abilities predict social trust (Sturgis et al., 2010).



Moreover, measures of cognitive abilities, such as intelligence, are predictors of various behavioural tendencies including alcohol consumption (Belasen and Hafer, 2013), attitude towards females (Salahodjaev and Azam, 2015), and patience (Jones and Podemski, 2010). This study further contributes to extant studies by demonstrating that cognitive abilities, a proxy for human capital, are positively and significantly related to climate change awareness. Moreover, we highlight that psychological facets, such as cognitive abilities, should not be ignored in research investigating the determinants of environmentalism.

Our empirical results are important for both policymakers and scholars, as there is an ongoing debate on the possible ways to reduce international environmental degradation. Our findings suggest that investing in human capital is not only beneficial to spur economic progress but also to raise the awareness of climate change among the population. One way to improve cognitive abilities is to allocate greater resources to health care and nutrition (Eppig et al., 2010). For example, Liu et al. (2013) explain that ‘children who do not regularly eat breakfast had lower full scale, verbal, and performance IQs compared to those who regularly do’ (p. 259).

However, one of the potential limitations of this research is that our key results may be affected by the simultaneous occurrence of a human capital transformation and a perception shift with respect to the environment or the potential omitted variable bias. We attempted to resolve the problem by including a rich set of lagged control variables in our empirical exercise. Yet, considering that cognitive abilities and climate change awareness measures are not collected every year, we cannot apply more sophisticated estimation methods at this time. This is an avenue for future research. Another limitation of this study is shaped by the nature of the data. Climate change awareness levels are available only on a cross-section basis. Thus, we are not able to account for the changes taking place since the global financial crisis, which, as studies demonstrate, affect a number of variables crucial for environmental awareness, such as corruption (Obydenkova and Arpino, 2017). Numerous studies (Lankina et al., 2016; Libman and Obydenkova, 2013, 2015; Obydenkova & Libman, 2015) address the historical legacies of social capital throughout the centuries, tracing its persistence from the late 19th century, throughout the 20th century and to the 21st century. This impact of pre-existing historical social capital on modernity is highly important, though difficult to trace.<sup>2</sup>

Finally, environmental protection and environmental awareness may be related to the policies of federal versus unitary states, as well as a number of subnational provinces, municipalities, and subnational political regimes (Libman and Obydenkova, 2014), based on Ostrom's framework on the interrelationship between democracy and environment. These issues need to be addressed in future research.

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